JC10 Rec'd PCT/PTO 18 DEC 2001

FORM-PTO-1390 (Rev. 9-2001) U.S. DEPARTMENT OF COMMERCE PATENT AND TRADEMARK OFFICE **TRANSMITTAL LETTER TO THE UNITED STATES DESIGNATED/ELECTED OFFICE (DO/EO/US) CONCERNING A FILING UNDER 35 U.S.C. 371**		ATTORNEY'S DOCKET NUMBER 000515-281 U.S. APPLICATION NO. (If known, see 37 C.F.R. 1.5) UNASSIGNED 10/018220
INTERNATIONAL APPLICATION NO. PCT/SE00/01296	INTERNATIONAL FILING DATE 16 June 2000	PRIORITY DATE CLAIMED 18 June 1999

TITLE OF INVENTION
A METHOD AND A DEVICE FOR BENDING COMPENSATION IN INTENSITY-BASED FIBRE-OPTICAL MEASURING SYSTEMS

APPLICANT(S) FOR DO/EO/US
Nevio VIDOVIC, Martin KRANTZ and Svante HÖJER

Applicant herewith submits to the United States Designated/Elected Office (DO/EO/US) the following items and other information:

1. ☒ This is a **FIRST** submission of items concerning a filing under 35 U.S.C. 371.
2. ☐ This is a **SECOND** or **SUBSEQUENT** submission of items concerning a filing under 35 U.S.C. 371.
3. ☐ This is an express request to begin national examination procedures (35 U.S.C. 371(f)). The submission must include items (5), (6), (9) and (21) indicated below.
4. ☒ The US has been elected by the expiration of 19 months from the priority date (Article 31).
5. ☒ A copy of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is attached hereto (required only if not communicated by the International Bureau).
   b. ☒ has been communicated by the International Bureau.
   c. ☐ is not required, as the application was filed in the United States Receiving Office (RO/US).
6. ☒ An English language translation of the International Application as filed (35 U.S.C. 371(c)(2))
   a. ☒ is attached hereto.
   b. ☐ has been previously submitted under 35 U.S.C. 154(d)(4).
7. ☒ Amendments to the claims of the International Application under PCT Article 19 (35 U.S.C. 371(c)(3))
   a. ☐ are attached hereto (required only if not communicated by the International Bureau).
   b. ☐ have been communicated by the International Bureau.
   c. ☐ have not been made; however, the time limit for making such amendments has NOT expired.
   d. ☒ have not been made and will not be made.
8. ☐ An English language translation of the amendments to the claims under PCT Article 19 (35 U.S.C. 371(c)(3)).
9. ☐ An oath or declaration of the inventor(s) (35 U.S.C. 371(c)(4)).
10. ☐ An English language translation of the annexes to the International Preliminary Examination Report under PCT Article 36 (35 U.S.C. 371(c)(5)).

Items 11 to 20 below concern document(s) or information included:

11. ☐ An Information Disclosure Statement under 37 CFR 1.97 and 1.98.
12. ☐ An assignment document for recording. A separate cover sheet in compliance with 37 CFR 3.28 and 3.31 is included.
13. ☒ A FIRST preliminary amendment.
14. ☐ A SECOND or SUBSEQUENT preliminary amendment.
15. ☐ A substitute specification.
16. ☐ A change of power of attorney and/or address letter.
17. ☐ A computer-readable form of the sequence listing in accordance with PCT Rule 13ter.2 and 35 U.S.C. 1.821 - 1.825.
18. ☐ A second copy of the published international application under 35 U.S.C. 154(d)(4).
19. ☐ A second copy of the English language translation of the international application under 35 U.S.C. 154(d)(4).
20. ☒ Other items or information:
    International Preliminary Examination Report, Unexecuted Declaration

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(10/01)

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U.S. APPLICATION NO (If known, see 37 CFR 1.5)	INTERNATIONAL APPLICATION NO	ATTORNEY'S DOCKET NUMBER
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21. ☒ The following fees are submitted:				CALCULATIONS	PTO USE ONLY
Basic National Fee (37 CFR 1.492(a)(1)-(5)): Neither international preliminary examination fee (37 CFR 1.482) nor international search fee (37 CFR 1.445(a)(2)) paid to USPTO and International Search Report not prepared by the EPO or JPO .... $1,040.00 (960) International preliminary examination fee (37 CFR 1.482) not paid to USPTO but International Search Report prepared by the EPO or JPO .... $890.00 (970) International preliminary examination fee (37 CFR 1.482) not paid to USPTO but international search fee (37 CFR 1.445(a)(2)) paid to USPTO .... $740.00 (958) International preliminary examination fee (37 CFR 1.482) paid to USPTO but all claims did not satisfy provisions of PCT Article 33(1)-(4) .... $710.00 (956) International preliminary examination fee (37 CFR 1.482) paid to USPTO and all claims satisfied provisions of PCT Article 33(1)-(4) $100.00 (962)					
ENTER APPROPRIATE BASIC FEE AMOUNT =				$ 1,040.00	
Surcharge of **$130.00 (154)** for furnishing the oath or declaration later than 20 ☐ 30 ☐ months from the earliest claimed priority date (37 CFR 1.492(e)).				$	
Claims	Number Filed	Number Extra	Rate		
Total Claims	11 -20 =	-0-	X$18.00 (966)	$ -0-	
Independent Claims	3 -3 =	-0-	X$84.00 (964)	$ -0-	
Multiple dependent claim(s) (if applicable)			+$280.00 (968)	$ -0-	
TOTAL OF ABOVE CALCULATIONS =				$ 1,040.00	
Reduction for 1/2 for filing by small entity, if applicable (see below). +				$ 520.00	-
SUBTOTAL =				$ 520.00	
Processing fee of **$130.00 (156)** for furnishing the English translation later than 20 ☐ 30 ☐ months from the earliest claimed priority date (37 CFR 1.492(f)). +				$ -0-	
TOTAL NATIONAL FEE =				$ 520.00	
Fee for recording the enclosed assignment (37 CFR 1.21(h)). The assignment must be accompanied by an appropriate cover sheet (37 CFR 3.28, 3.31). **$40.00 (581)** per property +				$ -0-	
TOTAL FEES ENCLOSED =				$ 520.00	
Received Amount Check $ 1,040.00 Q.				**Amount to be refunded:**	$
				charged:	$

a. ☒ Small entity status is hereby claimed.

b. ☒ A check in the amount of $ 520.00 to cover the above fees is enclosed.

c. ☐ Please charge my Deposit Account No. 02-4800 in the amount of $_______ to cover the above fees. A duplicate copy of this sheet is enclosed.

d. ☒ The Commissioner is hereby authorized to charge any additional fees which may be required, or credit any overpayment to Deposit Account No. 02-4800. A duplicate copy of this sheet is enclosed.

NOTE: Where an appropriate time limit under 37 CFR 1.494 or 1.495 has not been met, a petition to revive (37 CFR 1.137(a) or (b)) must be filed and granted to restore the application to pending status.

SEND ALL CORRESPONDENCE TO:

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NAME

36,075
REGISTRATION NUMBER

December 18, 2001
DATE

Patent
Attorney's Docket No. 000515-281

IN THE UNITED STATES PATENT AND TRADEMARK OFFICE

In re Patent Application of
Nevio VIDOVIC et al.
Application No.: UNASSIGNED
Filed: December 18, 2001
For: A METHOD AND A DEVICE FOR BENDING COMPENSATION IN INTENSITY-BASED FIBRE-OPTICAL MEASURING SYSTEMS

Group Art Unit: UNASSIGNED
Examiner: UNASSIGNED

PRELIMINARY AMENDMENT

Assistant Commissioner for Patents
Washington, D.C. 20231

Sir:

Prior to examination, please amend the above-identified application as follows:

IN THE ABSTRACT:

Kindly enter the Abstract submitted herewith on the sheet attached hereto.

IN THE CLAIMS:

Please amend claims 1 - 11 as follows:

1. (Amended) A method for bending compensation in intensity-based optical measuring systems, comprising a sensor element connected to a measuring and control unit via an optical connection and being adapted for providing a signal corresponding to a measurement of a physical parameter in connection with the sensor element, said method comprising

generation of a measuring signal that is brought to come in towards the sensor element,

generation of a reference signal that is transmitted through the optical connection without being influenced in the sensor element, said measuring signal and said reference signal having different wavelengths,

detection of said measuring signal and

detection of said reference signal,

characterized by comprising bending compensation through correction data based upon pre-stored data concerning the relationship between the measured reference signal and the measured measuring signal as a function of the bending influence upon said optical connection.

2. (Amended) The method according to claim 1, characterized by the feeding of said measuring signal to the sensor element causing optical interference in a cavity associated with the sensor element.

3. (Amended) The method according to claim 1, characterized by said correction data consisting of a stored table or function, describing a relationship measured beforehand, between the reference signal and the measuring signal, as a function of the bending influence.

4. (Amended) A method according to claim 1, characterized by being utilized for pressure measurements, said sensor element defining a membrane being affected by the pressure surrounding the sensor element.

5. (Amended) A device for measurements in optical measuring systems comprising: an optical connection connected to a sensor element adapted for providing a signal corresponding to a measurement of a physical parameter in connection with the sensor element; a first light source and a second light source arranged at the opposite end of the optical connection and functioning to emit a first light signal and a second light signal, respectively, at different wavelengths, the first light signal defining a measuring signal, brought to come in towards the sensor element, and the second light signal defining

a reference signal, conveyed through the optical connection without being influenced in the sensor element; a first detector intended for the detection of a light signal modulated by the sensor element; a second detector intended for the detection of a light signal reflected by the sensor element; and a computerized measuring and control unit, to which said detectors are connected,

characterized by said unit comprising means for processing the values detected by said detectors, means for storing data concerning the relationship between the measured reference signal and the measured measuring signal as a function of the bending influence upon said optical connection, and means for correcting the value detected by the first detector in dependence of said correction data.

6. (Amended) The device according to claim 5, characterized by said sensor element comprising a cavity, shaped so as to create optical interference when feeding said measuring signal into the cavity.

7. (Amended) The device according to claim 6, characterized by said cavity being obtained through building up molecular silicone and/or silicone dioxide layers, and an etching procedure.

8. (Amended) The device according to claim 7, characterized by said cavity being obtained through utilizing a bonding procedure.

9. (Amended) A measuring system for measuring a physical parameter influencing a sensor element adapted to be connected to a measuring and control unit, characterized by comprising a separate information-carrying unit comprising a memory and being adapted for connection to said measuring and control unit, said information-carrying unit being co-ordinated with the sensor element by containing stored information regarding the properties of the measuring system and the sensor element during measurements.

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10. (Amended) The measuring system according to claim 9, wherein said sensor element is connected to said measuring and control unit via an optical connection, characterized by said stored information including pre-defined correction data concerning the relationship between the measured reference signal and the measured measuring signal as a function of the bending influence upon said optical connection.

11. (Amended) The measuring system according to claim 9, characterized by said reference signal and said measuring signal being of the same wavelength.

REMARKS

The above changes to the claims have been made to delete multiple dependency of the claims, to round out the scope of patent protection being sought, and generally to place the claims in better condition for examination on the merits.

Respectfully submitted,

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Date: December 18, 2001

Attachment to Preliminary Amendment dated December 18, 2001

Marked-up claims 1 - 11

1. (Amended) A method for bending compensation in intensity-based optical measuring systems, comprising a sensor element [(8)] connected to a measuring and control unit [(16)] via an optical connection [(4)] and being adapted for providing a signal corresponding to a measurement of a physical parameter in connection with the sensor element [(8)], said method comprising

generation of a measuring signal [(λ_1)] that is brought to come in towards the sensor element [(8)],

generation of a reference signal [(λ_2)] that is transmitted through the optical connection [(4)] without being influenced in the sensor element [(8)], said measuring signal and said reference signal having different wavelengths,

detection of said measuring signal [(λ_1)] and

detection of said reference signal [(λ_2)],

[characterised] characterized by comprising bending compensation through correction data based upon pre-stored data concerning the relationship between the measured reference signal [(λ_2)] and the measured measuring signal [(λ_1)] as a function of the bending influence upon said optical connection [(4)].

2. (Amended) The method according to claim 1, [characterised] characterized by the feeding of said measuring signal [(λ_1)] to the sensor element [(8)] causing optical interference in a cavity [(8a)] associated with the sensor element [(8)].

3. (Amended) The method according to claim 1, [characterised] characterized by said correction data consisting of a stored table or function, describing a relationship measured beforehand, between the reference signal [(λ_2)] and the measuring signal [(λ_1)], as a function of the bending influence.

Attachment to Preliminary Amendment dated December 18, 2001

Marked-up claims 1 - 11

4. (Amended) A method according to [any one of the preceding claims] claim 1, [characterised] characterized by being [utilised] utilized for pressure [(p)] measurements, said sensor element [(8)] defining a membrane [(8b)] being affected by the pressure [(p)] surrounding the sensor element [(8)].

5. (Amended) A device for measurements in optical measuring systems comprising[;]: an optical connection [(4)] connected to a sensor element [(8)] adapted for providing a signal corresponding to a measurement of a physical parameter in connection with the sensor element [(8)]; a first light source [(2)] and a second light source [(3)] arranged at the opposite end of the optical connection [(4)] and functioning to emit a first light signal [(λ_1)] and a second light signal [(λ_2)], respectively, at different wavelengths, the first light signal [(λ_1)] defining a measuring signal, brought to come in towards the sensor element [(8)], and the second light signal [(λ_2)] defining a reference signal, conveyed through the optical connection [(4)] without being influenced in the sensor element [(8)]; a first detector [(12)] intended for the detection of a light signal modulated by the sensor element [(8)]; a second detector [(13)] intended for the detection of a light signal reflected by the sensor element; and a [computerised] computerized measuring and control unit [(14)], to which said detectors [(12, 13)] are connected,

[characterised] characterized by said unit [(14)] comprising means for processing the values detected by said detectors [(12, 13)], means for storing data concerning the relationship between the measured reference signal [(λ_2)] and the measured measuring signal [(λ_1)] as a function of the bending influence upon said optical connection [(4)], and means for correcting the value detected by the first detector [(12)] in dependence of said correction data.

6. (Amended) The device according to claim 5, [characterised] characterized by said sensor element [(8)] comprising a cavity [(8a)], shaped so as to create optical interference when feeding said measuring signal [(λ_1)] into the cavity [(8a)].

Attachment to Preliminary Amendment dated December 18, 2001

Marked-up claims 1 - 11

7. (Amended) The device according to claim 6, [characterised] characterized by said cavity [(8a)] being obtained through building up molecular silicone and/or silicone dioxide layers, and an etching procedure.

8. (Amended) The device according to claim 7, [characterised] characterized by said cavity [(8a)] being obtained through [utilising] utilizing a bonding procedure.

9. (Amended) A measuring system for measuring a physical parameter [(p)] influencing a sensor element [(8)] adapted to be connected to a measuring and control unit [(16)], [characterised] characterized by comprising a separate information-carrying unit [(18)] comprising a memory and being adapted for connection to said measuring and control unit [(16)], said information-carrying unit [(18)] being co-ordinated with the sensor element [(8)] by containing stored information regarding the properties of the measuring system and the sensor element [(8)] during measurements.

10. (Amended) The measuring system according to claim 9, wherein said sensor element [(8)] is connected to said measuring and control unit [(16)] via an optical connection [(4)], [characterised] characterized by said stored information including pre-defined correction data concerning the relationship between the measured reference signal and the measured measuring signal as a function of the bending influence upon said optical connection [(4)].

11. (Amended) The measuring system according to claim 9 [or 10], [characterised] characterized by said reference signal and said measuring signal [are] being of the same wavelength.

ABSTRACT

The invention relates to a method for bending compensation in intensity-based optical measuring systems, comprising a sensor element connected to a measuring and control unit via an optical connection, and being adapted for providing a signal corresponding to a measurement of a physical parameter in connection with the sensor element, said method comprising the generation of a measuring signal that is brought to come in towards the sensor element, the generation of a reference signal that is transmitted through the optical connection without being influenced in the sensor element, said measuring signal and said reference signal having different wavelengths, the detection of said measuring signal and the detection of said reference signal. The invention is characterized by comprising bending compensation through correction data based upon pre-stored data concerning the relationship between the measured reference signal and the measured measuring signal as a function of the bending influence on said optical connection. The invention also relates to a device for carrying out said method. Through the invention, measurements with an optical pressure measuring system are allowed, which exhibit effective compensation for any bending of the optical connection.

TITLE:

A METHOD AND A DEVICE FOR BENDING COMPENSATION IN INTENSITY-BASED FIBRE-OPTICAL MEASURING SYSTEMS

TECHNICAL FIELD

The present invention relates to a method for measuring systems according to the preamble of the appended claim 1. The invention is especially intended for use with intensity-based fibre-optical measuring systems for pressure measurements. The invention also relates to a device for carrying out such a method, according to the preamble of the appended claim 5.

BACKGROUND ART

In connection with measuring physical parameters such as pressure and temperature, it is previously known to utilise various sensor systems by which the optical intensity of a ray of light, conveyed through an optical fibre and coming in towards a sensor element, is influenced due to changes in the respective physical parameter. Such a system may for example be used when measuring the blood pressure in the veins of the human body. Said system is based upon a transformation from pressure to a mechanical movement, which in turn is transformed into an optical intensity, conveyed by an optical fibre, which is in turn transformed into an electrical signal that is related to the measured pressure.

According to known art, such a fibre-optical measurement system may comprise a pressure sensor, an optical fibre connected to said pressure sensor, and at least one light source and at least one light detector located at the opposite end of the fibre, in order to provide the pressure sensor with light, and to detect the information-carrying light signal returning from the pressure sensor, respectively.

One problem occurring with previously known systems of the above kind relates to the fact that interference may occur in the signal transmission path,

for example caused by fibre couplings or through bending, intentionally or unintentionally, of the fibre. Already at a light deflection of the fibre, a reduction of the light signal occurs. This signal damping, caused by the bent fibre, entails that the light signal detected in the light detector, which is related to the pressure detected in the sensor element, will have a value that does not coincide with the real pressure. The size of the deviation will then depend on how much the fibre was deflected.

Through EP 0 528 657 A2 a fibre-optical measurement system for measuring pressure is known. Said system comprises a pressure sensor with a membrane, three LED:s emitting light at different wavelengths, and two photo detectors. The system is arranged so that a computing algorithm is used for correction of such temperature effects that may have been superimposed on the output pressure signal. This algorithm is based upon the relationship between membrane deflection, pressure and temperature. Correction data obtained experimentally may also be used as input data to the algorithm regarding temperature compensation.

DISCLOSURE OF INVENTION

A primary object of the present invention is to compensate, by means of a method and a device, for interference in intensity-based fibre-optical sensor systems, caused by intentional or unintentional bending of the optical fibre. This is achieved by means of a method and a device in accordance with the present invention, the characteristics of which are defined in the accompanying claims 1 and 5, respectively.

The invention is intended for bending compensation in intensity-based optical measurement systems comprising a sensor element connected to a measuring and control unit via an optical connection and adapted for providing a signal corresponding to a measurement of a physical parameter in connection with the sensor element. The invention comprises; the generation of a measuring signal that is brought to come in towards the

sensor element; the generation of a reference signal that is transmitted through the optical connection without being influenced in the sensor element, said measuring signal and said reference signal having different wavelengths; and the detection of said measuring signal and the detection of said reference signal. The invention is characterised by comprising bending compensation through correction data based upon pre-stored data concerning the relationship between the measured reference signal and the measured measuring signal as a function of the bending influence on said optical connection.

Advantageous embodiments of the invention are defined by the subsequent dependent claims.

BRIEF DESCRIPTION OF DRAWINGS

The invention will be explained in more detail below, with reference to a preferred embodiment and to the enclosed drawings, in which:

Fig. 1 shows, schematically, a pressure measuring system according to the present invention;

Fig. 1a shows an enlarged view of a sensor element intended for use in connection with the invention;

Fig. 2 shows a graph illustrating the relationship between a measured reference signal and a measured measuring signal as a function of the bending influence, in accordance with a method according to the invention; and

Fig. 3 shows, in principle, a pressure measuring system in which a so-called "smart card" can be used as the information-carrying memory unit.

PREFERRED EMBODIMENTS

Fig. 1 shows, schematically, an intensity-based fibre-optical measuring system 1 according to the present invention. According to a preferred embodiment, the arrangement is used in connection with a fibre-optical

measuring system of an as such previously known kind, which could preferably, but not exclusively, consist of a pressure measuring system. Alternatively, the invention could be used e.g. for measuring temperature and acceleration.

Two light sources belong to the system 1, comprising a first LED 2 and a second LED 3, the first LED 2 functioning to emit a first light signal of a first wavelength λ_1 and the second LED 3 functioning to emit a second light signal of a second wavelength λ_2, said wavelengths being different. The LED:s 2, 3 are connected to an optical conduit, preferably in the form of an as such previously known optical fibre 4, by means of a first link 5 and a second link 6, respectively, and also via a fibre coupling 7. The optical fibre 4 is connected to a sensor element 8, schematically illustrated in Fig. 1.

According to what is shown in detail by Fig. 1a, which is an enlarged view of the sensor element 8, said element comprises a cavity 8a, for example obtainable (according to known art) through construction by means of molecular layers (primarily silicone, alternatively silicone dioxide or a combination of the two) and an etching procedure. Preferably, a bonding procedure is also utilised in assembling the various layers of the sensor element 8. The manufacture of such a sensor element 8 is as such previously known, e.g. from the Patent Document PCT/SE93/00393. In this way, a membrane 8b is also created within the sensor element 8, the deflection of which membrane will depend on the pressure p surrounding the sensor element 8.

According to what will be described in detail below, the first light signal with the first wavelength λ_1 will come in and be reflected against the cavity 8a within the pressure sensor 8, whereas the second light signal with the second wavelength λ_2 is brought to come in onto the bottom side of the sensor element 8, i.e. towards the interface between the pressure sensor 8 and the

optical fibre 4. Hereby, the first light signal will be modulated by the pressure p acting on the membrane 8b. When the membrane 8b is influenced, the dimensions of the cavity 8a, primarily its depth d, will change, entailing a modulation of the first light signal through optical interference inside the cavity 8a.

The second light signal will be reflected against the bottom side of the sensor element 8, due to the fact that the silicone defining the sensor element 8 will only allow transmission of light with a wavelength longer than a certain limit value (e.g. 900 nm). Consequently, said first wavelength λ_1 will be selected so as to exceed this limit value. Contrary to this, said second wavelength λ_2 will be selected so as to fall below this limit value. After having determined the two wavelengths λ_1, λ_2, appropriate dimensions of the cavity 8a are determined. For example, the depth of the cavity 8a is selected to be a value of substantially the same magnitude as the two wavelengths λ_1, λ_2. The sizing of the cavity 8a is made considering the required application range for the sensor element 8 (in the current case primarily the pressure range to which the sensor element 8 is to be adapted).

The light signal (λ_1) emitted from the first LED 2 defines a measuring signal that is thus transmitted through the fibre 4 to the sensor element 8, where said light signal will be modulated in the manner described above. The second light signal (λ_2) will then define a reference signal, transmitted through the fibre 4 and being reflected by the bottom side 9 of the sensor element 8. The light signal modulated in the sensor element 8 and the light signal reflected from the bottom side 9 of the sensor element are then transmitted back through the fibre 4. The returning light signals will, through the fibre coupling 7, be conveyed into fibre links 10, 11, connected to the detectors 12 and 13, respectively. The detectors 12, 13 will detect the measuring signal and the reference signal, respectively.

The four links 5, 6, 10, 11 preferably consist of optical fibres, the fibre coupling 7 thereby preferably consisting of an as such known fibre junction device designed so as to transfer the four fibre links 5, 6, 10, 11 into the fibre 4 leading to the sensor element 8.

The system 1 also comprises a computerised measuring and control unit 14, to which the LED:s 2, 3 and the detectors 12, 13 are connected. Said unit 14 comprises means for processing the values detected by said detectors 12, 13. According to the invention, the processing of the detected values includes a compensation for intentional or unintentional bending of the fibre 4, by utilising correction data based upon pre-stored data concerning the relationship between a measured reference signal and a measured measuring signal as a function of the bending influence on the optical fibre 4. Such correction data could for example be comprised of a table or a function defining values to be used during measurements to correct the detected measuring signal.

Finally, the system 1 comprises a presentation unit 15, e.g. a display, allowing a measurement of the sensed pressure p to be visualised for a user.

Fig. 2 graphically illustrates how the above relationship between a measured reference signal and a measured measuring signal is changed during increased bending of the fibre 4. In the figure, the reference signal is referenced as "Output signal λ_2 [V]" and the measuring signal as "Output signal λ_1 [V]". Said measured relationship can be described by a function, so as to correct the measuring signal continuously with a specific value depending on the reference signal. Alternatively, the measured relationship can be used for defining a mathematical function, which in turn is used for producing corrected values during measurements with the system according to the invention. As a further alternative, a number of measurement values may be registered in a table, into which the value of the reference signal is

entered, to obtain a value (with the aid of interpolation, if necessary), with which the current measuring signal is corrected. Independently of the correction procedure used, it is performed in the above-mentioned measuring and control unit 14.

Fig. 3 shows, in principle, a pressure measuring system according to the invention, comprising an alternative measuring unit 16 to which the sensor element 8 is connected, via the optical fibre 4, in an exchangeable manner via an optical coupling (not shown in Fig. 3). Said measuring unit 16 also comprises a reader unit 17 for insertion and reading of a separate unit in the form of an information-carrying card 18 (also called "smart card"). Said card 18 comprises a memory device where data regarding the sensor element 8 are stored for use. During measurements, these data may be read by the measuring unit 16 and be used for example for bending compensation in dependence of which specific sensor element 8 that is being used for the moment. The invention thus provides a further advantage, in that different sensor elements 8 can be connected to said unit 16 without calibration, thanks to data stored on the information-carrying card 17. Said data preferably define the relationship between predetermined correction data, produced through measurements of the first as well as the second light signal at various degrees of bending of the optical fibre.

The invention is especially suitable in case a single measurement station with one measuring unit 16 is used together with several exchangeable sensor elements. In such a case, data corresponding to properties, measuring range, etc. of each sensor element, can be stored on a corresponding number of information-carrying cards, each then corresponding to (and being used together with) a specific sensor element.

As an alternative to an information-carrying unit in the form of a card, the invention can also be used with other types of separate data carriers. Further, the measuring system according to Fig. 3, as opposed to what is

shown in Figs 1 and 2, is not limited to measurements of the kind using two different wavelengths, but can also be used when measuring with for example only one wavelength.

It should be mentioned, that the card 18 may also contain other stored information than that mentioned above, e.g. information regarding the sensor type, calibration data, etc. The basic principle is, however, that the card 18 is co-ordinated with a specific sensor element such that it will comprise stored data regarding the function of the specific sensor element. Preferably, the card 18 will be provided with information - in the form of a set of parameters - allowing the properties of the sensor element 8, together with the properties of the measuring unit 16, to provide a suitable linearisation of the characteristics of the specific sensor element during measurements.

The invention is not limited to the embodiment described above, but may be varied within the scope of the appended claims. For example, the principle for data storage regarding a specific sensor on a separate information-carrying card can be used also for systems not intended for pressure measurements.

CLAIMS

1. A method for bending compensation in intensity-based optical measuring systems, comprising a sensor element (8) connected to a measuring and control unit (16) via an optical connection (4) and being adapted for providing a signal corresponding to a measurement of a physical parameter in connection with the sensor element (8), said method comprising

generation of a measuring signal (λ_1) that is brought to come in towards the sensor element (8),

generation of a reference signal (λ_2) that is transmitted through the optical connection (4) without being influenced in the sensor element (8), said measuring signal and said reference signal having different wavelengths,

detection of said measuring signal (λ_1) and

detection of said reference signal (λ_2),

characterised by comprising bending compensation through correction data based upon pre-stored data concerning the relationship between the measured reference signal (λ_2) and the measured measuring signal (λ_1) as a function of the bending influence upon said optical connection (4).

2. The method according to claim 1, characterised by the feeding of said measuring signal (λ_1) to the sensor element (8) causing optical interference in a cavity (8a) associated with the sensor element (8).

3. The method according to claim 1, characterised by said correction data consisting of a stored table or function, describing a relationship measured beforehand, between the reference signal (λ_2) and the measuring signal (λ_1), as a function of the bending influence.

4. A method according to any one of the preceding claims, characterised by being utilised for pressure (p) measurements, said sensor element (8) defining a membrane (8b) being affected by the pressure (p) surrounding the sensor element (8).

5. A device for measurements in optical measuring systems comprising; an optical connection (4) connected to a sensor element (8) adapted for providing a signal corresponding to a measurement of a physical parameter in connection with the sensor element (8); a first light source (2) and a second light source (3) arranged at the opposite end of the optical connection (4) and functioning to emit a first light signal (λ_1) and a second light signal (λ_2), respectively, at different wavelengths, the first light signal (λ_1) defining a measuring signal, brought to come in towards the sensor element (8), and the second light signal (λ_2) defining a reference signal, conveyed through the optical connection (4) without being influenced in the sensor element (8); a first detector (12) intended for the detection of a light signal modulated by the sensor element (8); a second detector (13) intended for the detection of a light signal reflected by the sensor element; and a computerised measuring and control unit (14), to which said detectors (12, 13) are connected,
characterised by said unit (14) comprising means for processing the values detected by said detectors (12, 13), means for storing data concerning the relationship between the measured reference signal (λ_2) and the measured measuring signal (λ_1) as a function of the bending influence upon said optical connection (4), and means for correcting the value detected by the first detector (12) in dependence of said correction data.

6. The device according to claim 5, characterised by said sensor element (8) comprising a cavity (8a), shaped so as to create optical interference when feeding said measuring signal (λ_1) into the cavity (8a).

7. The device according to claim 6, characterised by said cavity (8a) being obtained through building up molecular silicone and/or silicone dioxide layers, and an etching procedure.

8. The device according to claim 7, characterised by said cavity (8a) being obtained through utilising a bonding procedure.

9. A measuring system for measuring a physical parameter (p) influencing a sensor element (8) adapted to be connected to a measuring and control unit (16), characterised by comprising a separate information-carrying unit (18) comprising a memory and being adapted for connection to said measuring and control unit (16), said information-carrying unit (18) being co-ordinated with the sensor element (8) by containing stored information regarding the properties of the measuring system and the sensor element (8) during measurements.

10. The measuring system according to claim 9, wherein said sensor element (8) is connected to said measuring and control unit (16) via an optical connection (4), characterised by said stored information including pre-defined correction data concerning the relationship between the measured reference signal and the measured measuring signal as a function of the bending influence upon said optical connection (4).

11. The measuring system according to claim 9 or 10, characterised by said reference signal and said measuring signal are of the same wavelength.

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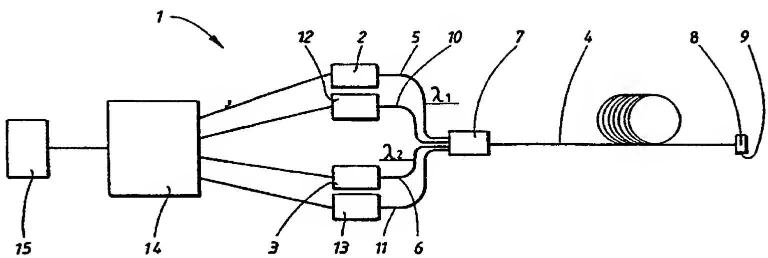
(54) Title: A METHOD AND A DEVICE FOR BENDING COMPENSATION IN INTENSITY-BASED FIBRE-OPTICAL MEASURING SYSTEMS



(57) Abstract: The invention relates to a method for bending compensation in intensity-based optical measuring systems, comprising a sensor element (8) connected to a measuring and control unit (16) via an optical connection (4), and being adapted for providing a signal corresponding to a measurement of a physical parameter in connection with the sensor element (8), said method comprising the generation of a measuring signal (λ_1) that is brought to come in towards the sensor element (8), the generation of a reference signal (λ_2) that is transmitted through the optical connection (4) without being influenced in the sensor element (8), said measuring signal and said reference signal having different wavelengths, the detection of said measuring signal (λ_1) and the detection of said reference signal (λ_2). The invention is characterised by comprising bending compensation through correction data based upon pre-stored data concerning the relationship between the measured reference signal (λ_2) and the measured measuring signal (λ_1) as a function of the bending influence on said optical connection (4). The invention also relates to a device for carrying out said method. Through the invention, measurements with an optical pressure measuring system are allowed, which exhibit effective compensation for any bending of the optical connection.

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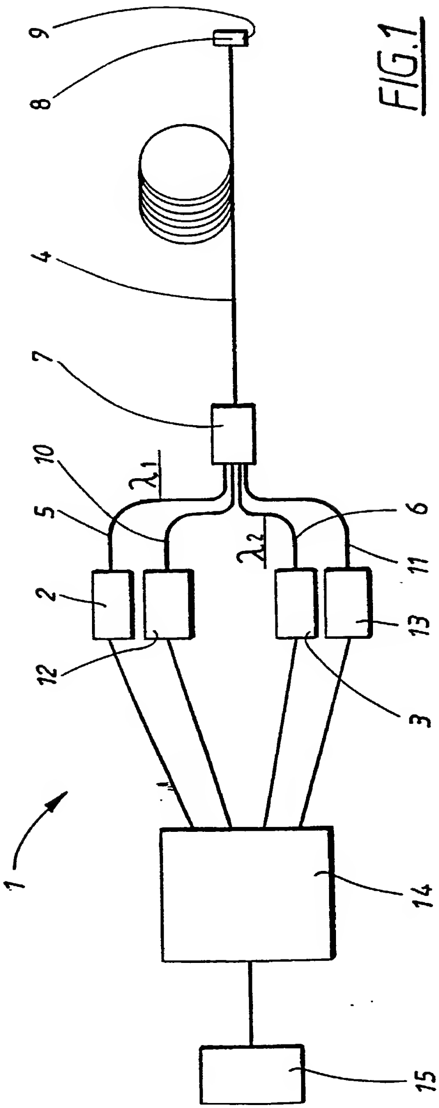
1
2
3
4
5
6
7
8
9
10
11
12
13
14
15
λ_1
λ_2

FIG.1

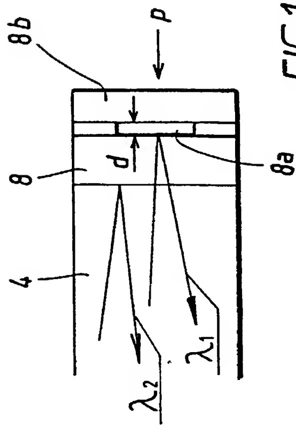
8b
p
d
8
8a
4
λ_1
λ_2

FIG.1a

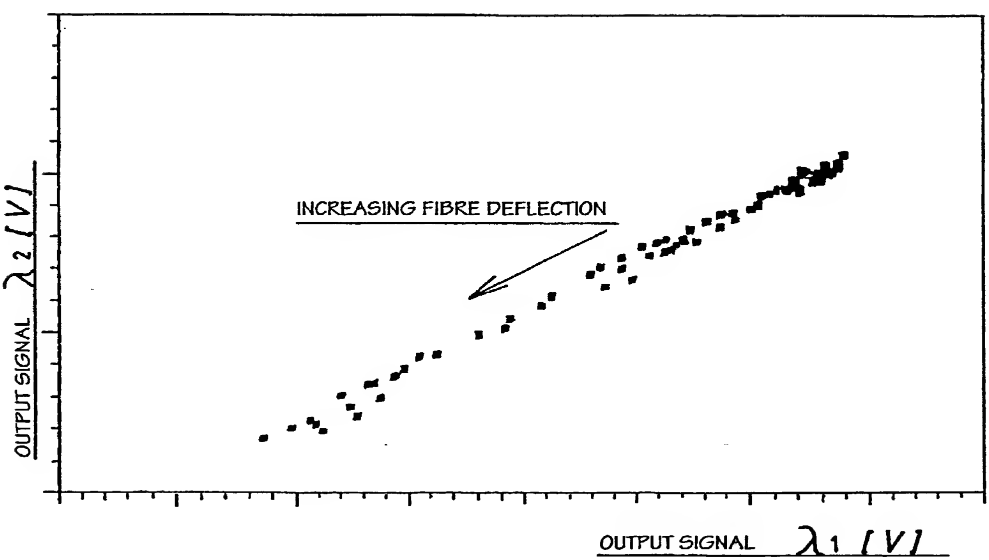
INCREASING FIBRE DEFLECTION
OUTPUT SIGNAL λ_2 [V]
OUTPUT SIGNAL λ_1 [V]

FIG. 2

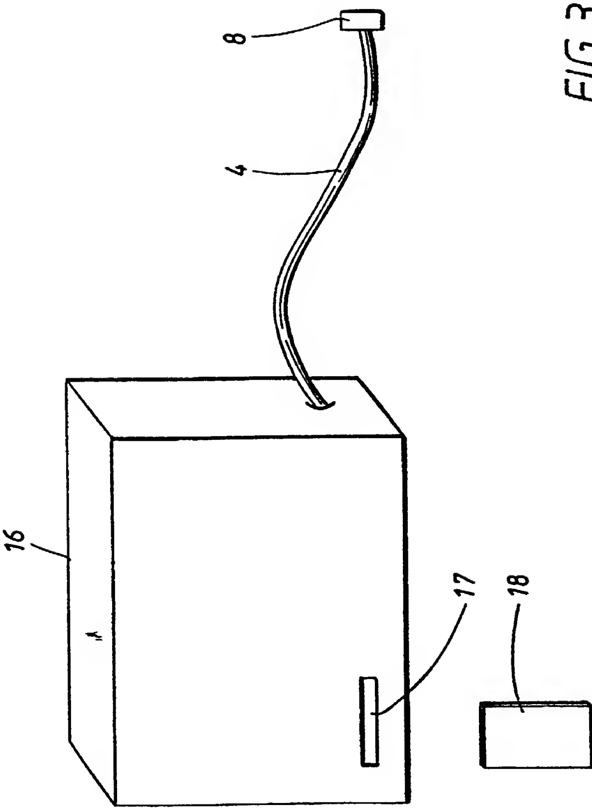

FIG.3

#4

000515-281
Attorney's Docket No.

COMBINED DECLARATION FOR PATENT APPLICATION AND POWER OF ATTORNEY
(Includes Reference to PCT International Applications)

As a below named inventor, I hereby declare that:

My residence, post office address and citizenship are as stated below next to my name;

I believe I am the original, first and sole inventor (if only one name is listed below) or an original, first and joint inventor (if plural names are listed below) of the subject matter which is claimed and for which a patent is sought on the invention entitled:

A METHOD AND A DEVICE FOR BENDING COMPENSATION IN INTENSITY-BASED FIBRE-OPTICAL MEASURING SYSTEMS

the specification of which (check only one item below):

☐ is attached hereto.

☐ was filed as United States application
Number ______ on ______
and was amended on ______ (if applicable).

☒ was filed as PCT international application
Number PCT/SE00/01296 on April 18, 2000
and was amended on January 18, 2001 (if applicable).

I hereby state that I have reviewed and understand the contents of the above-identified specification, including the claims, as amended by any amendment referred to above.

I acknowledge the duty to disclose to the Office all information known to me to be material to patentability as defined in Title 37, Code of Federal Regulations, §1.56.

I hereby claim foreign priority benefits under Title 35, United States Code, §119 (a)-(d) of any foreign application(s) for patent or inventor's certificate or of any PCT international application(s) designating at least one country other than the United States of America listed below and have also identified below any foreign application(s) for patent or inventor's certificate or any PCT international application(s) designating at least one country other than the United States of America filed by me on the same subject matter having a filing date before that of the application(s) of which priority is claimed:

PRIOR FOREIGN/PCT APPLICATION(S) AND ANY PRIORITY CLAIMS UNDER 35 U.S.C. §119(a)-(d):				
COUNTRY (if PCT, indicate "PCT")	APPLICATION NUMBER	DATE OF FILING (day, month, year)	PRIORITY CLAIMED UNDER 35 U.S.C. §119	
SWEDEN	9902320-2	18 June 1999	X Yes	No
			Yes	No
			Yes	No
			Yes	No
			Yes	No

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I hereby declare that all statements made herein of my own knowledge are true and that all statements made on information and belief are believed to be true; and further that these statements were made with the knowledge that willful false statements and the like so made are punishable by fine or imprisonment, or both, under Section 1001 of Title 18 of the United States Code and that such willful false statements may jeopardize the validity of the application or any patent issued thereon.

1-00

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